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It is probable that the formation in the western localities mentioned is mostly sand. Near Carson City, Nevada, it consists of a light-buff friable calcareous sandstone.

This is the Upper Pliocene of King and the Post-pliocene of various writers.

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## A PATHOGENIC SCHIZOPHYTE OF THE HOG.[1]

BY PROFESSOR H. J. DETMERS.

ABOUT twenty-five years ago Professors Brauell and Pollender in Dorpat, Russia, made an important discovery, which, though at first not considered as of much significance, soon led to investigations, the results of which have already revolutionized the ætiology of contagious and infectious diseases. Brauell and Pollender, and soon afterwards also Dr. Leisering in Dresden, discovered in the blood of man and beast, affected with anthrax or splenic fever, an infinite number of exceedingly fine, apparently solid, almost transparent, straight and motionless, rod-shaped bodies (cf. Virchow's Archiv. für Pathol., Anat. und Physiol., und für Klinische Medicin, XI, 2). They called them *staebchenfoermige Koerper* (Bacilli), but left it undecided whether the same bear a casual connection with the morbid process, constitute a product of the same, or are merely accidental. Still, finding these Bacilli in every fatal case of anthrax, Brauell and Pollender considered their presence as something characteristic, and as of great diagnostic and prognostic value. As early as 1860 the relation of these Bacilli to anthrax formed a topic of discussion in the annual meeting of the Veterinary Society of the Grand Duchy of Oldenburg. Later investigations, but especially those by Davaine, Koch, Cohn, Pasteur, Toussaint, and more recently by Dr. Hans Buchner, in Munich, have demonstrated beyond a doubt that these Bacilli, first discovered by Brauell and Pollender of the Imperial Veterinary School of Russia at Dorpat, and first known as Brauell and Pollender's *staebchenfoermige Koerper*, constitute the real and sole cause, and also the infectious principle, of that terrible disease known as anthrax or *Milzbrand* to the Germans, charbon to the French, and anthrax or splenic fever to the English. About the same time, or soon after Brauell and Pollender published their discovery, other similar microscopic bodies were found, not only in the blood and morbid products in contagious diseases, but also in a great many other things, particularly in putrefying, decomposing, and fermenting substances, in pus, secretions of wounds, in the mucus of the mouth, etc. All this, however, is well known, and as I do not intend to give a history of the discoveries in regard to these minute bodies, comprehended under the generic name of Schizophytes, nor dwell upon the investigations made by many European and some American scientists for the purpose of ascertaining the true character and the relation of those Schizophytes to contagious and so-called zymotic diseases, I will only make one further remark, and then briefly relate what I have seen and ascertained myself. I mentioned the discovery of Brauell and Pollender as a fit introduction to what I shall have to say, and also for the purpose of correcting certain erroneous statements in American literature, which ascribe the first discovery of *Bacillus anthracis* to Davaine, and to other French investigators. For a long time it remained a puzzling question how certain Schizophytes, found in certain diseases in the blood, exudations, and other animal fluids, etc., can constitute the cause and infectious principle of those diseases, while other Schizophytes, apparently identical, or at least very similar in appearance, and of almost universal occurrence, are known to be perfectly harmless. To illustrate, it will only be necessary to mention the great similarity between *Bacillus anthracis* and *Bacillus subtilis*, two of the best known Schizophytes. This question has been solved by the researches of Dr. Hans Buchner in Munich (cf. his monography "Ueber de Experimentelle Erzeugung des Milzbrand Contagiums aus den Heupilzen, und ueber die Entstehung des Milzbrandes durch Einathmung, Muenchen, 1880"). Dr. Buchner, by repeated and continued cultivations in solutions of meat extract, with and without an addition of peptone and sugar, succeeded in converting *Bacillus anthracis* into *Bacillus subtilis*; 36 generations made the former harmless, and about 1500 generations converted the same into a veritable hay-bacillus or *Bacillus subtilis*. Vice versa, by continued and repeated cultivations in fresh blood Dr. Buchner also succeeded in changing a harmless *Bacillus subtilis* into an exceedingly malignant *Bacillus anthracis*, which, introduced into the organism of a healthy animal by inoculation, in every instance caused sure and speedy death. But as all this is on record, published in works and periodicals just as accessible to my readers as to myself, or perhaps more so, as my present residence is in a country town, I shall not dwell upon it any longer.

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[1] Read before the Chicago Academy of Sciences.

It is now fourteen years ago, when so-called Texas fever was decimating the cattle in Central Illinois, the peculiarities of that disease, the characteristic morbid changes, the long period of incubation, and particularly the manner in which the disease was said to be communicated by Texas cattle to native animals, led me to think that some microscopic organism, endowed with life and power of propagation, and subject to changes and metamorphoses, must constitute the cause and the means of infection. I communicated my views to the Hon. John P. Reynolds, then Secretary of the Illinois State Board of Agriculture, and now Chief Grain Inspector of Chicago. My communication, written in very poor English, and coming from an unknown person living in a country town in Northern Illinois, was published in two Chicago papers, but did not procure me an opportunity to make an investigation. Still, even if it had, the investigation, very likely, would not have resulted in anything. In the first place, I had neither the means to procure, nor the necessary experience to use, a first-class microscope, and moreover doubt whether, at that time, fourteen years ago, an instrument was in existence in America that could have successfully coped with the question. Our first-class homogeneous immersion objectives were not known then. My suggestions to Hon. John P. Reynolds, whether known or unknown to them, I do not know, were partially carried out, or acted upon, by Professor Gamgee and his associates, and by the Commissioners of the State of New York (cf. New York Agricultural Report of 1867), but no satisfactory results were obtained. The New York Commissioners even went so far as to send some bile to Professor Hallier in Jena, who, of course, found and cultivated a great variety of fungi, and left the whole thing in a more confused state than it ever was. At any rate, the whole investigation, as far as the ætiology of Texas fever is concerned, did not throw much light upon the subject.

A little over three years ago I was requested by the late Commissioner of Agriculture, Hon. Wm. G. Le Duc, to investigate a very fatal disease of swine, known to the farmers as hog cholera, and from the reports of the Department of Agriculture as swine plague. I procured a No. 8 Hartnack stand, with three eye-pieces and three Hartnack objectives, a 1 inch, a ¼ inch, and a four-system $\frac{1}{9}$ inch, with correction and immersion. Of course, such an instrument was not at all what was needed, but it was the best I could get, and, to tell the truth, the best I was then able to handle. It soon revealed the presence of microscopic organisms —Schizophytes, or, if preferred, Microbes or Bacteria—in the morbid products of the disease, and in the blood of the diseased and dead animals, but its definition and its magnifying power, about 800 diameters, were not sufficient to show the characteristics of the Schizophytes, and to distinguish the same under all circumstances from other bacteria similar in size. Consequently I made several, under the circumstances excusable, errors. If the light happened to be very good and well adjusted, a micrococcus chain appeared as a moniliform rod, and if the light was not very good, as I am sorry to say was very often the case, a Micrococcus chain could not be distinguished from a rod-shaped Bacterium or a Bacillus. All this was very much of a drawback; still I became soon convinced that in the morbid products of the disease and in the blood of the diseased and dead hogs, I had to deal with a specific Schizophyte, which does not occur in the blood, etc., of other animals not affected with swine plague, and is entirely different from *Bacterium termo*, because I observed whenever putrefaction set in, and *Bacterium termo* made its appearance, my swine plague Schizophytes commenced to disappear, and disappeared in about the same ratio in which *Bacterium termo* increased in numbers. Being unfortunately not sufficiently familiar with the classification of Schizophytes, and the distinguishing characteristics of micrococci, bacteria, bacilli, etc., as laid down by Cohn and others, the inadequacy of my microscope caused me to commit a blunder, for which I have to apologize. Professor Klein in England, in his investigation of swine plague, also found a Schizophyte, which he called a "*Bacillus*." Not knowing then, as I do now, that his bacillus, seen with better instruments than that at my command, was an intruder, and not at home where found, and having no doubt whatever that he had seen the identical Schizophyte which I saw and found in every case of swine plague, I proposed the name *Bacillus suis*. As soon as Cohn's classification of Schizophytes fell into my hands I saw my mistake, and endeavored to correct the same in my next report to the Commissioner of Agriculture, two years ago, in as plain language as I can command; but not knowing at that time the spuriousness of Professor Klein's bacillus, I did not say anything about it. Still, a colaborer—it will not be necessary to give his name—does not appear to be satisfied, misconstrues my language, and yet insists that I call the swine-plague Schizophyte a *Bacillus suis*. But enough of this. It widely differs from a bacillus as defined by Cohn. One of its most characteristic features consists in its forming zoöglœa-masses or coccoglia, which, according to Cohn, a bacillus never does. It also does not form straight and motionless rods, nor is its effect directly poisoning, or causing decomposition, like that of *Bacillus anthracis*, but mostly, if not entirely, brought about in a mechanical way, by its mere presence, and by a withdrawal from the animal organism of such elements as are needed for its existence, its metamorphoses, and its propagation. To put it in a few words, it acts like a veritable parasite. I discarded the name Bacillus as soon as I discovered my mistake, and have simply called it Swine-plague Schizophyte or Swine-plague Microbe, leaving it to others, better versed in the classification of Schizophytes, to give it an appropriate name.

About two years ago I obtained the means, a large Beck's stand and a Tolles' $\frac{1}{10}$ homogeneous immersion objective, which enabled me not only to make a more thorough investigation, but also to distinguish, as to shape, form, size, and undergoing-changes, the swine-plague Schizophytes from other Schizophytes classed under the various heads of Micrococci, Bacteria and Bacilli, and particularly from those which invariably make their appearance in all animal fluids and tissues when putrefaction or decomposition is setting in. Still, the amplification to be obtained by eyepiecing without any loss of definition—about 925 to 1000 diameters—proved to be insufficient. Certain characteristics, which I had reason to suppose are existing, and of which I could obtain only occasional glimpses, could not be seen, or were to be seen only in an imperfect manner. I therefore requested Mr. Tolles to make for my special work an objective which, if possible, would give as good and sharp definition with an amplification of 1500 diameters as the $\frac{1}{10}$ in my possession with 925. Mr. Tolles has nobly responded, and it is but just to say that the objective he made, nominally a $\frac{1}{15}$, but in reality close up to a $\frac{1}{17}$, is not only equal, but in some respects even superior to a magnificent $\frac{1}{18}$ homogeneous immersion objective of Zeiss, which I was fortunate enough to procure last spring. It, the Zeiss objective, is a trifle higher than a $\frac{1}{20}$. These two objectives, the $\frac{1}{15}$ Tolles, and the $\frac{1}{18}$ Zeiss, have been almost exclusively used during the last year. The $\frac{1}{15}$ of Tolles gives, with the No. 2 eyepiece, according to length of tube and collar correction, from 1356 to 1525 diameters.

The Swine-plague Schizophytes present themselves in three, and probably in four, or even five, different forms. As to the three different forms I am certain, as to the fourth and possibly fifth I will not be so positive. The form to begin with is that of a very minute spherical body, a micrococcus of 0. 7 to 0. 8 $\mu$ in diameter. It is invariably present in the blood and blood serum, in all morbid products and exudations, and in such morbid tissues as can be conveniently examined with high power objectives while fresh. It probably is not necessary to state that the micrococci of Swine-plague, being spherical, do not present any characteristic difference from other micrococci, occurring in other substances, if the latter happen to be of about the same size as the former. Still, differences can be observed, if the micrococci are kept under the microscope for some time—a few hours—at a suitable temperature. The Swine-plague micrococci soon form zoöglœa-masses or aggregate in clusters and become imbedded in an apparently viscous substance. While thus imbedded they soon commence to duplicate by growing in two opposite directions, and at the same time becoming contracted in the middle. This contraction gradually becomes plainer and plainer, and increases in the same degree in which the micrococcus is growing in length, till finally the latter presents the

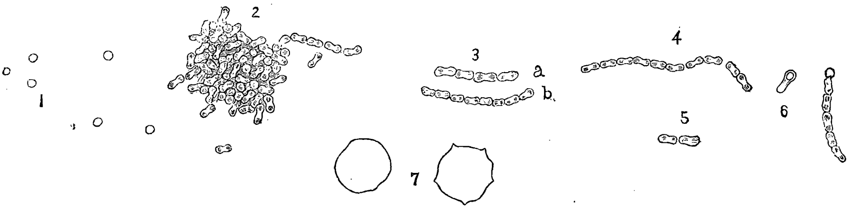

FIG. 1.—1, Swine-plague Micrococci; 2, do. Coccoglia; 3, do. Micrococcus-chain —*b*, five minutes later than *a*; 4, do. do. parting; 5, do. do. pasted joint with flagellum; 6, Helobacteria with lasting spore; 7, blood corpuscles. × 1525 objective: Tolles' $\frac{1}{15}$ homog. immersion.

appearance of two closely connected spherical bodies without any visible partition, and somewhat resembles the shape of a figure 8. At this stage the now bispherical micrococcus is about twice as long as its transverse diameter, or measures about 1.5 $\mu$. In the interior of each spherical body a somewhat darker substance, or a kind of a nucleus can be observed. This duplication, or process of division, which occurs in a large number of micrococci at the same time, it seems, finally breaks the glia, or the viscous mass, which apparently holds the micrococcus cluster together; the micrococci, many, or perhaps most of them now bispherical, and some yet single, become free and make their exit. Whether the glia constitutes the pabulum needed to effect this growth and duplication, and is gradually consumed, or whether the same only serves to hold the micrococci together, and breaks because its contents become too large or too voluminous, I am not able to decide. These zoöglœa-masses occur and can be found, though seldom in large numbers, in the fresh blood and blood serum; and are very numerous, and often very large in the morbid tissues, the exudations, particularly the lung exudations, and blood extravasations, and in the morbid products in general. I never found them absent. The bispherical, and also the single micrococci, when freed from their glia, do not cease to multiply by fission; on the contrary, the process of division proceeds with great rapidity, provided the temperature is not too low. At an ordinary temperature, say about 70° to 75°, a double or bispherical micrococcus is often changed into a small chain of two double micrococci, connected endways, in less than 5 minutes. While the process of division is thus going on, and the single cells of such a bispherical micrococcus are becoming double by a longitudinal growth, and becoming contracted in the middle, the orig-

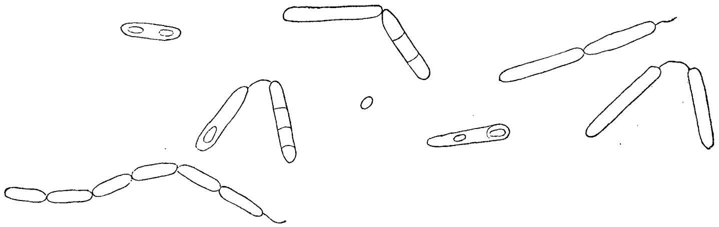

FIG. 2.—Schizophytes (Bacilli) found in the blood of the vena cava posterior of a cow which died of Texan fever. × 925 objective: Tolles' duplex $\frac{1}{10}$ homog. immersion.

inal contraction between the secondary cells also gradually increases and becomes deeper, till it finally appears like a separation, and then the end walls of both cells appear to be closed; the connecting neck cannot be seen, and the cells, now two bispherical micrococci, seem to merely touch each other. The single micrococci, too, become double or bispherical, and those already double gradually increase to chains of various length, and not dissimilar in appearance to a chain of an old-fashioned watch. These micrococcus-chains I consider as the third form spoken of. The same, however, hold together only temporarily, or for a short time, and then break up into larger or smaller joints, each joint consisting of one or more bispherical micrococci. When these chains separate or break up, the separation is not a sudden nor a rapid one; on the contrary, the bispherical micrococci which are about to separate appear to become at first more loosely connected with the rest of the chain; do not seem to be in as close a contact with the adjoining portion as before; a small space between them becomes visible; still there is evidently yet a connection, because the movement of the separating joints, although apparently independent, are limited to a swinging to and fro. The space, however, gradually widens, till finally a separation takes place, and each link or joint goes its way. If the light is very good and well adjusted, and the human eye in first-rate condition, an objective like my Tolles' $\frac{1}{15}$ or Zeiss' $\frac{1}{18}$ will reveal the existence of an exceedingly slender thread, a flagellum, which, gradually lengthening and finally snapping apart, constituted the connecting link or medium between the separating joints. I have repeatedly seen it as a post-flagellum when the joint or bispherical micrococcus was slowly moving, but so far have never seen one at both ends. It may here be remarked, I have never seen any single micrococci separating from such a chain or its joints, consequently the single or spherical micrococci must have another source or origin; but there is little hope that the latter will ever be fully revealed, unless our makers of objectives—men like Tolles, Zeiss, Powell and Leland, and others—will succeed in producing objectives which will give as good and sharp definitions, with an amplification of 2500 or 3000 diameters, as their best ones now in existence are giving with 1200 or 1500 diameters. Still, there is a multitude of other much larger Schizophytes, and concerning them our present means are about sufficient to observe what cannot be seen in regard to the very minute swine-plague Schizophytes. Therefore, a little more than what is really known about the latter may almost safely be inferred from analogy. But I will not enter into speculations, and, at any rate, first state what I have seen. Sometimes in perfectly fresh blood serum and in fresh lung-exudation, and almost always in blood serum and lung-exudation 12 to 24 hours old, and also in the mucus and morbid products of a diseased piece of intestine, peculiar-shaped Schizophytes can be found. The same are rod-shaped, but have at one end, or sometimes towards the middle, a very bright granule, which strongly refracts the light, and consequently is more dense than the rest of the bacterium. It is of about the same diameter as the rod itself. This granule is surrounded or enveloped by a zone or ring—possibly a membrane—which is less dense, and much less light-refracting. The whole rod, therefore, if this granule is situated at one end, as is usually the case, presents the shape of a club, or rather that of a short stick with a bright round knob at one end. It is a so-called Helobacterium (Billroth), and the bright and dense or light-refracting granule is a so-called lasting spore (Dauerspore of Billroth).

*(To be continued.)*

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# ON CERTAIN ABORIGINAL IMPLEMENTS FROM NAPA COUNTY, CALIFORNIA.[1]

BY ROBERT E. C. STEARNS.

THE figures herewith presented illustrate a collection made by me in October, 1881, on the top of Howell mountain, in Napa county.

The mortars are exteriorly rude unworked stones, generally of much harder quality than most of the country rock in the neighborhood. Fig. 1 is the most symmetrical of the five specimens collected; in this respect it is the least characteristic; otherwise so far as diameter and depth of the concavity are considered, it is a fair type of all.

I was unable to find a single specimen, or even a fragment,

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[1] Read before the California Academy of Sciences, October 19, 1881.